Information of www.infonet-biovision.org 0%

Fodder Production and Conservation


Fodder production


Conservation of maize stovers


Hay making


Silage making

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What is Infonet-Biovision?

Infonet-Biovision is an information platform tailored to the rural population in East Africa. It offers information on sustainable agriculture and ecological control of plant-, human- and animal-targeting pests and disease vectors.

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targeting pests and disease vectors.

It also provides information on simple and environmentally safe technologies and approaches to improve the rural populations life and generate income while at the same time protecting the environment and the natural resources.

Infonet-Biovision's aim is to contribute to poverty reduction and environmental protection by disseminating appropriate and locally adapted methods for crop and livestock production, and for human and environmental health.

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On the Infonet-BioVision platform you find local relevant and effective information with contributions of local experts and international scientists on:

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- organic agriculture and crop husbandry for food security
- effective ecological prevention and control of plant-, human- and animal targeting pests and diseases
- simple and environmentally safe technologies and approaches to improve your life and generate income while at the same time protecting the environment and the natural resources

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http://www.infonet-biovision.org

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Where do I find information on Infonet-Biovision?

The structure of Infonet-Biovision is organised and programmed in such a way that the information provided forms a practical working tool for farmers, extension workers and trainers.

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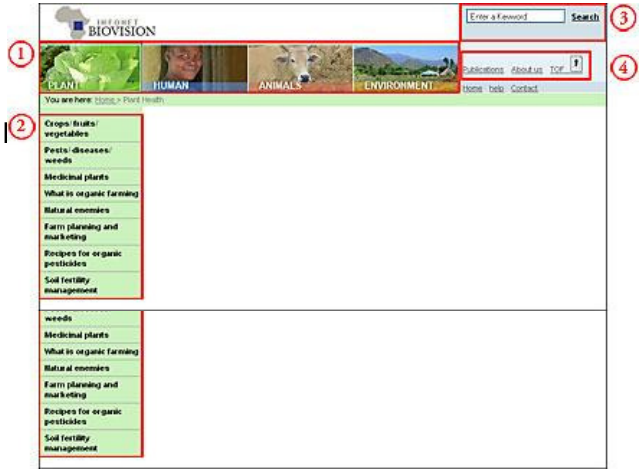
Infonet Home

Infonet Navigation Overview



1. **Horizontal image navigation (on the top)**
2. **Vertical List Navigation (in left column)**
3. **Infonet Keyword Search (on the top right corner)**
4. **Publications, About us and TOF (The Organic Farmer Magazine)**

1. Horizontal image navigation (on the top)

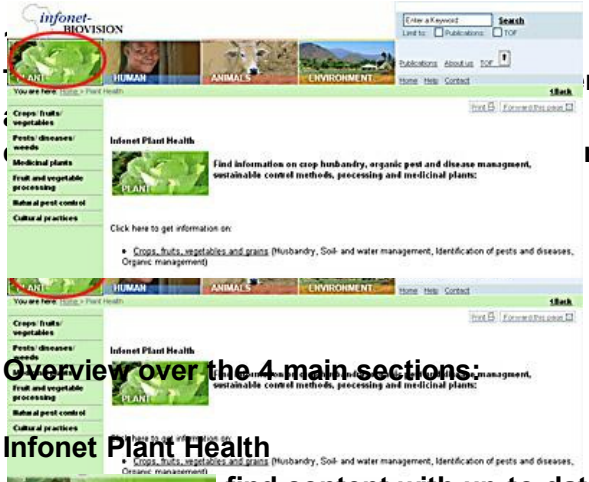
2. Vertical List Navigation (in left column)

3. Infonet Keyword Search (on the top right corner)

1. Horizontal image navigation (on the top)

4. Publications, About us and TOF (The Organic Farmer Magazine)

The main sections (plant, human, animal, environment) for information about sustainable agriculture, health and ecological methods are accessible by the horizontal image navigation bar. By clicking on one of the images the selected main section will appear.



nvironment) for information about sustainable

are accessible by the horizontal image navigation bar. By

main section will appear.

Overview over the 4 main sections:

Infonet Plant Health

find content with up-to-date (reviewed) information and images on plant health issues such as:

(a) major crops, fruits, vegetables and grains - husbandry, soil- and water management, identification of pests and diseases and organic management

(b) major pests and diseases, preventive and curative management measures, background on biology and ecology

(c) medicinal plants with income generating potential

Overview over the 4 main sections:

Infonet Plant Health

find content with up-to-date (reviewed) information and images on plant health

(d) sustainable control methods - introduction to the terms: organic farming, conservation farming, (agroforestry) - description of different control methods and when to apply them: plant nutrition, plant extracts & biopesticides, natural enemies, physical methods, cultural control practices: (composting, crop rotation, green manure, mulching, field sanitation, weed management, trap cropping, conservation tillage etc...)

(e) fruit and vegetable processing (how to make tomato pulp, jars, how to dry, construction of a dryer) (f) Natural pest control - Logical approach to pest control by using the least-toxic products that minimize harm to beneficial insects

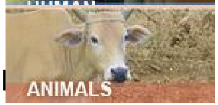
(g) Cultural practices - Information about conservation agriculture, alternatives to herbicides, vegetable crop weed management etc...

more information will follow

Infonet Human Health

find information on integrated and preventive control of malaria and what to do on individual and community level (i.e. water and pond management, bed nets, treatment, case study on education and awareness). More information will follow soon on basic hygiene, nutrition, sanitation, waste-management, water- and soil borne diseases and their prevention

Infonet Animal Health



find information about organic animal husbandry, animal diseases prevention and management for cattle, donkeys, poultry, camels, pigs, goats, geese, bees and fish-farming and more

Infonet Animal Health

Infonet Environmental Health

find information about organic animal husbandry, animal diseases prevention and management for cattle, donkeys, poultry, camels, pigs, goats, bees, rabbits and fish-farming, and water management methods, soil conservation, agroforestry, homegarden, income generation methods

Infonet Environmental Health

find simple and environmentally safe technologies and approaches, sustainable energy use, water management methods, soil conservation, agroforestry, homegarden, income generation methods

2. Vertical List Navigation (in left column)

After selection one of the main sections (Plant, Human, Animals, Environment) more information about that section is offered on vertical list navigation bar.

Infonet left navigation 1

lant, Human, Animals, Environment) more information
t navigation bar.

By clicking on one of the list items the sub-navigation of the selected item will be displayed. A click to a sub-navigation item will display the content on the right.

Infonet left navigation 2

-navigation of the selected item will be displayed. A click
ntent on the right.

3. Infonet Keyword Search (on the top right corner)

For searching all infonet contents enter any keywords (e.g. 'banana pest') at the field on the right corner and click with your mouse pointer to 'Search'.

Infonet search 1

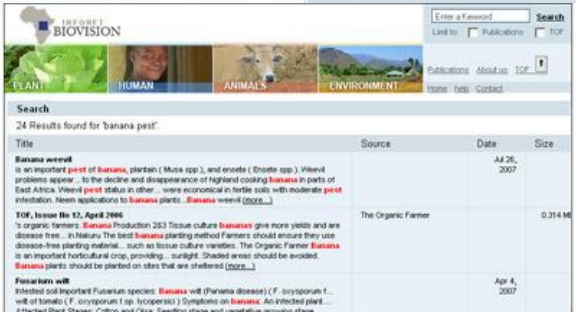
rner)

ywords (e.g. 'banana pest') at the field on the right

The result page will list all pages, publications and issues from TOF (The Organic Farmer Magazine) containing your entered keyword (marked in red). For more information about the list results click on the underlined links 'more...'

Infonet search 1

Infonet search 2



and issues from TOF (The Organic Farmer Magazine)

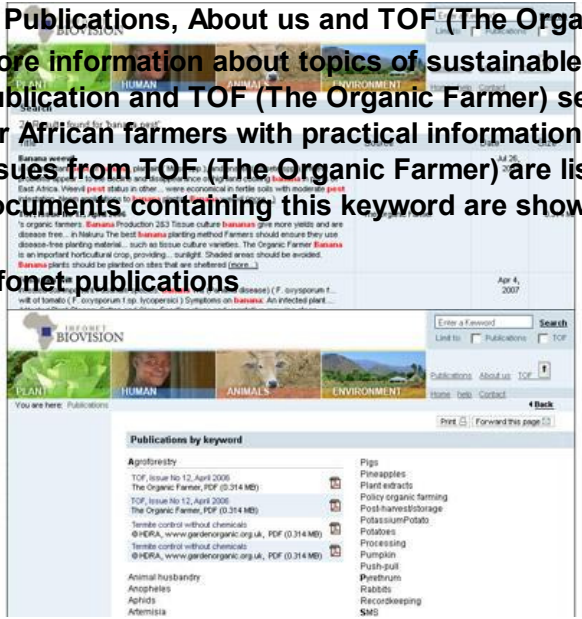
d). For more information about the list results click

Infonet search 2

4. Publications, About us and TOF (The Organic Farmer Magazine)

More information about topics of sustainable agriculture and ecological control can be found at the publication and TOF (The Organic Farmer) section. The Organic Farmer (TOF) is a free magazine for African farmers with practical information about sustainable agriculture. The publications and issues from TOF (The Organic Farmer) are listed by keyword. By clicking on a keyword all the documents containing this keyword are shown.

Infonet publications



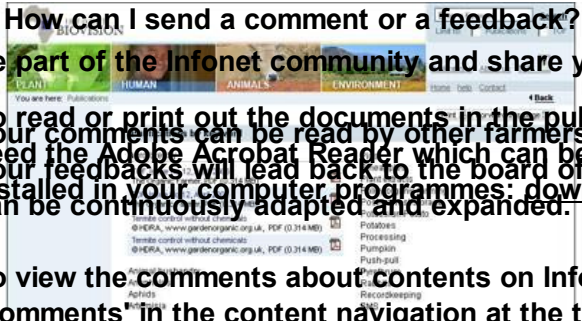
c Farmer Magazine)

griculture and ecological control can be found at the tion. The Organic Farmer (TOF) is a free magazine bout sustainable agriculture. The publications and ed by keyword. By clicking on a keyword all the .

Infonet publications

To read or print out the documents in the publications and TOF (The Organic Farmer) section you need the Adobe Acrobat Reader which can be downloaded for free from here if you don?t have it installed in your computer programmes: download here the Adobe Acrobat Reader

5. How can I send a comment or a feedback?



Be part of the Infonet community and share your experience.

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Your comments can be read by other farmers and will help exchanging experiences from the field. Your feedbacks will lead back to the board of advisory scientists so that the information presented can be continuously adapted and expanded.

To view the comments about contents on Infonet-Biovison or post your comments click on 'Comments' in the content navigation at the top on the right side.

5. How can I send a comment or a feedback?

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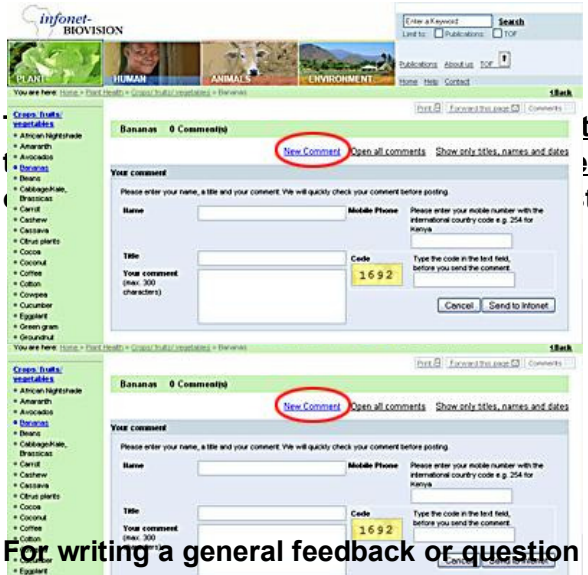

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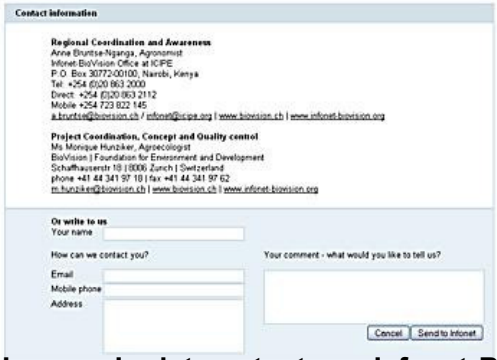

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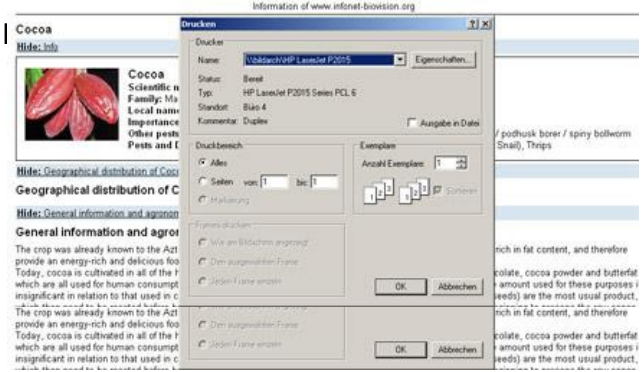
Infonet print 1

Infonet print 1

Confirming the opening print dialogue you send the page to your printer.

Infonet print 2 **d the page to your printer.**



Information of www.infonet-biovision.org

Search

Publications Abbreviations TOF

Home Help Contact

You are here: Home > Human Health > Insect Transmitted Diseases > Malaria **Back**

Print

Nutrition and nutritional diseases

Insect Transmitted

Malaria
Parasites: *Plasmodium falciparum, P. vivax, P. ovale, P. malariae*
Vector: *Anopheles* spp.

Search

Publications About us TOF

Home Help Contact

You are here: Home > Human Health > Insect Transmitted Diseases

Back

Print

Nutrition and nutritional diseases

Insect Transmitted

5.1 Breeding sites

Search

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Back

Print

Nutrition and nutritional

diseases

Insect Transmitted Diseases

Malaria

Water Borne Diseases

Air Borne Diseases

Zoonotic diseases

Hygiene and Sanitation

Malaria

1. Introduction Images

Anopheles sp.

Anopheles gambiae biting human arm

- Malaria is currently the world's most important disease ... More than 40% of the world's population in 100 countries are threatened by malaria. The annual incidence of malaria cases ranges from 300 to 500 million persons.
- According to the World Health Organization (WHO) Malaria is responsible for the death of 1.5 to 2.7 million people each year. African countries south of the Sahara suffer most and account for 90% of deaths caused by malaria. Most

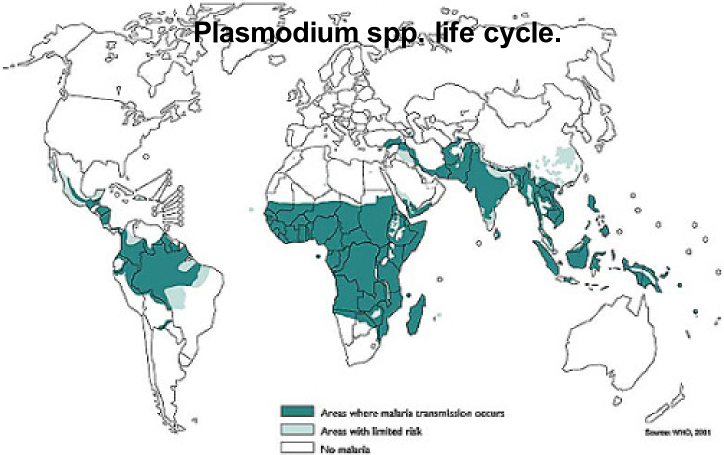
[illegible]

www.cdc.gov/malaria

Main zone with malaria caused by *Plasmodium falciparum* (ma... in red)

© Curtis C.F. (Courtesy of EcoPort, www.ecoport.org)

Plasmodium spp. life cycle.



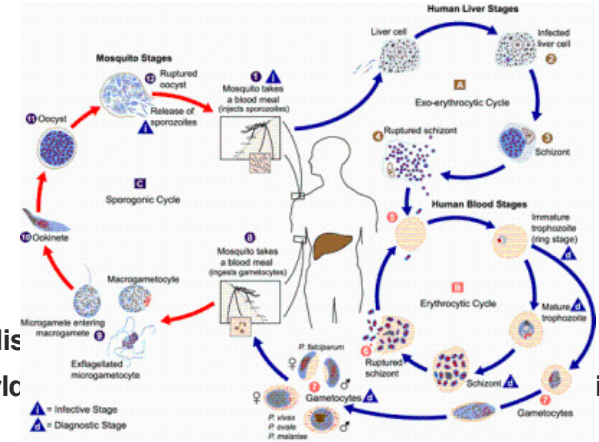
...der five... www.oxfam.org ... To view document click here ... of 20
...reaching the age of five years.

...stitute for Microbiology, Swiss Federal Institute of
...humans as well as to other vertebrates (host) by
...the genus Anopheles (vector). The causative agents
...belonging to the genus Plasmodium. The cycles of
...the vector and the host are highly complex.
...ww.who.int/malaria/
...g/wiki/Anopheles

back to Index

So far no prote... only means to fight against malaria are integrated vector manage... measures are only recommended for short term stays in endem...

back to Index

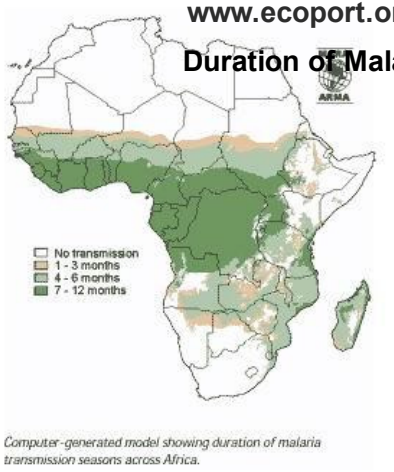


World wide dis

© WHO (Worl **ith/en/)**

© CDC (Courtesy of EcoPort, www.ecoport.org)

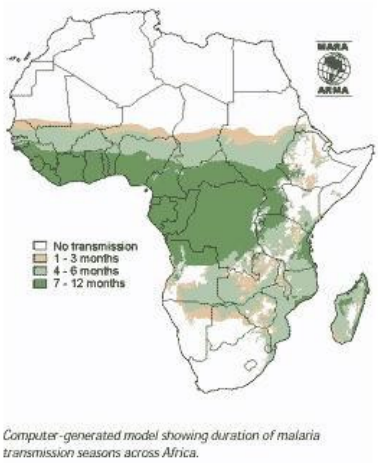
Duration of Malaria Transmission Season



Computer-generated model showing duration of malaria transmission seasons across Africa.

Duration of Ma

© MARA / ARM **rica. www.mara.org.za**



Computer-generated model showing duration of malaria transmission seasons across Africa.

© MARA / ARMA Mapping
Malaria Risk in Africa
www.mara.org.za

2. Anopheles r **aria**

General

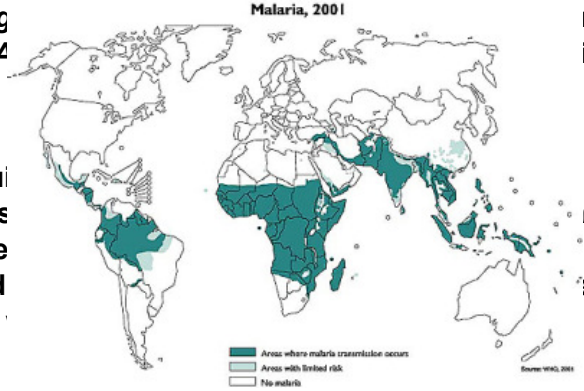
Anopheles is a **e). There are approximately 460 recognised species: while over 100** **only 30-40 commonly transmit parasites of the genus *Plasmodium* th** **s humans in endemic areas. *Anopheles gambiae* is one of the best kno** **nt role in the transmission of the deadly species - *Plasmodium fa***

Some species of *Anopheles* also can serve as the vectors for canine heartworm *Dirofilaria immitis*, the Filariidae *Wuchereria bancrofti* and *Brugia malayi*, and viruses like the one that is the cause of O'nyong'nyong fever. Mosquitoes in other genera (*Aedes, Culex*) can also serve as vectors of disease agents.

Geographical distribution of Malaria

Malaria is transmitted by female *Anopheles* mosquito from one human host to the other during the blood meals. The protozoan parasites taken up from an infected person reaches the mosquito gut together with the blood. The intestine of the mosquito is the starting point for the cycle of the plasmodium within the vector. Ten to fourteen days later the plasmodia are found in the salivary glands of the mosquito, ready to be injected and to infect another person.

World wide several hundred species assigned to the genus *Anopheles* have been identified. Only about 40 species are able to transmit malaria. The most prominent vector of malaria in sub-Saharan

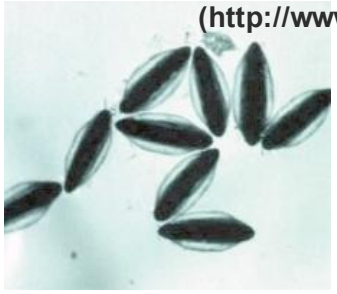
is *Anopheles g*  **rs in sub Saharan Africa are *Anopheles funestus* and *A*** **inately zoophilic (prefers animals).**

The life cycle

Like all mosqui **in their life cycle: egg, larva, pupa, and imago. The firs** **ys, depending on the species and the ambient tempe** **Anopheles mosquito acts as malaria vector. The ad** **e in captivity) but most probably do not live more than 1-2**

Anopheles egg

© WHO (World Health Organization) (http://www.who.int/ith/en/)



***Anopheles* spp.**

© Entomology and Plant Pathology, Oklahoma State University (www.ento.okstate.edu/mosquito/biology.html)

The female mosquito lays her eggs on the water surface.

Anopheles larva

Larvae hatch from the eggs, and pass through 4 stages.

© Stephen L. Dogett, NSW Arbovirus Surveillance & Vector Monitoring Program

So called larvae hatch from the eggs, start to take up nutrients and pass through four larval stages before undergoing transformation to the pupal stage. The picture shows a fourth instar larva resting below the water surface.

Anopheles pupa

The adult (imago) mosquito emerges from the pupa.

© Stephen L. Dogett, NSW Arbovirus Surveillance & Vector Monitoring Program

The fourth instar larva is transformed into a pupa from which the adult emerges.

Anopheles sp.

Following mating with males, the females search for a blood meal. Eggs are produced, and the reproduction cycle is closed.

The cycle can take between 7-16 days and is influenced by temperature and humidity - the higher the temperature and humidity the more rapid the life cycle.

Anopheles gambiae biting human arm

© Curtis C.F. (Courtesy of EcoPort, www.ecoport.org)

Malaria transmission and control

Understanding the biology and behavior of *Anopheles* mosquitoes can help understand how malaria is transmitted and can aid in designing appropriate control strategies. Factors that affect a mosquito's ability to transmit malaria include its innate susceptibility to Plasmodium, its host choice and its longevity. Factors that should be taken into consideration when designing a control program include the susceptibility of malaria vectors to insecticides and the preferred feeding and resting location of adult mosquitoes.

Breeding sites

The presence of water is essential for any mosquito to complete its cycle. The Anopheles larvae can develop in numerous different water habitats, from shaded ponds and pools to hoof prints and car tracks. Anophelines tend to prefer water that is clean. But some Anopheles species have been shown to breed in polluted drains.

Biting behaviour

Anopheles **mosquitoes bite preferably from dusk to dawn. In many instances, malaria infected mosquitoes are late night biters whereby older mosquitoes are more likely to be infected. These are often found biting between 12am to 4am. But be careful: Different species of anopheles mosquitoes may have different peaks of biting times, preferences (animals or humans) and different resting habits (indoor or outdoors). Blood fed mosquitoes rest indoor in dry or windy areas where safe, outdoor resting sites are scarce.**

3. Plasmodia, the parasites

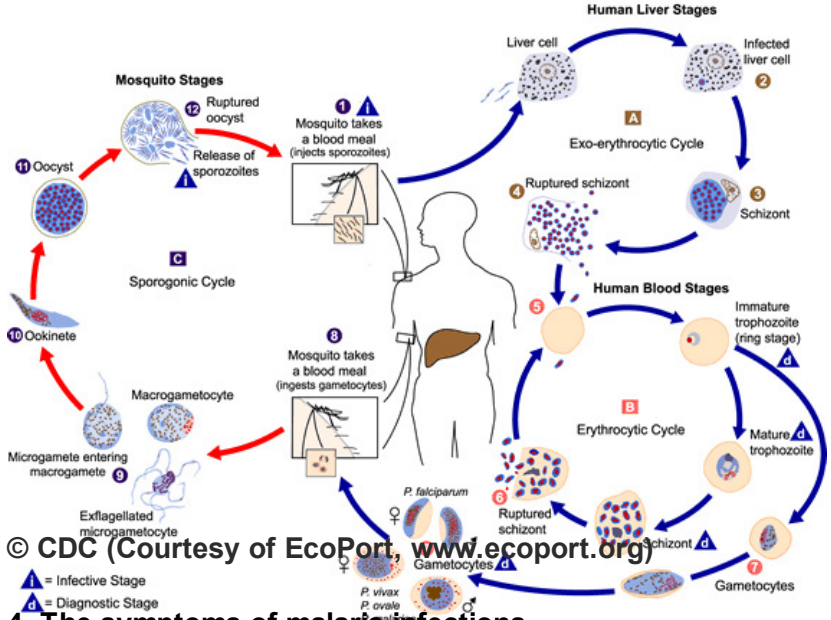
The causative agents of malaria are protozoan belonging to the genus Plasmodium. There are four different species of Plasmodium that infect humans, namely *Plasmodium falciparum, P. vivax, P. ovale* and *P. malariae*. Each has different incubation times, i.e. the time elapsing between the infection and the appearance of the first symptoms. *Plasmodium falciparum*, the most prevalent and most dangerous species in Africa has an incubation time of 10 to 14 days.

As the figure shows, the development of the *Plasmodium* species are very complex, divided into a cycle within the vector, and within the host, respectively. If a female *Anopheles* has fed on blood infected with Plasmodium, the parasite undergoes various stages within the mosquito. Ten to fourteen days later, so called sporozoites accumulate in the salivary glands of the mosquito and are

injected into the human blood stream. The Plasmodia migrate to the liver where they multiply. Thereafter, parasites return to the bloodstream where they invade the red blood cells. The synchronous rapid multiplication resulting in the destruction of blood cells trigger the well known, characteristic symptoms such shivering, fever and sweating.

P. falciparum **is the cause of "malignant" or cerebral malaria that can quickly lead to unconsciousness and death. Untreated or poorly treated malaria infections can cause recurring fevers.**

Plasmodium spp. life cycle.



4. The symptoms of malaria infections

Symptoms:

The main symptom of malaria is fever caused by the simultaneous rupturing of red blood cells, followed by a large-scale multiplication of the *Plasmodium* parasites. The febrile stages are often accompanied by chills and sweating. Other symptoms may be headache and joint pains. *P. falciparum* infections cause very often severe, life-threatening conditions such as organ failures, manifested by coma, impairment of consciousness, or other neurological abnormities. Further symptoms of severe malaria are anemia (destruction of red blood cells), hemoglobinuria

(hemoglobin in the urine), pulmonary edema (fluid buildup in the lungs), and cardiovascular collapse. Severe malaria occurs most often in persons who have no immunity to malaria or whose immunity has decreased. These include residents of areas with low or no malaria transmission, and especially young children and pregnant women in areas with high transmission.

Diagnosis:

A definitive diagnosis of malaria can only be made by examination of blood samples. This is a relatively straightforward procedure requiring a finger prick of blood. However, microscopy facilities are needed to examine the blood slide and these are often not available. It is accepted as appropriate in most endemic countries to treat cases of fever even though only a percentage of them may actually be confirmed as malaria. Typhoid, meningitis and pneumonia are often wrongly diagnosed as malaria on clinical examination alone.

Treatment:

Antimalarian treatment policies have undergone important changes over the past years. This is mainly thanks to the development of drugs based on artemisinin and its derivatives. Artimisinin is extracted from *Artemisia annua*, a plant used for centuries in China for malaria therapy. Artemisinin-based combinations (ATC) represent the best options to treat malaria. Artemisinin can be combined with traditional drugs such as lumefantrine, amodiaquine, mefloquine or sulfadoxine-pyrimethamine. The reader is referred to the WHO guidelines for the treatment of malaria (click to follow link)

5. Reduction of malaria transmission by integrated vector management (IVM)

Malaria transmission and control

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The presence of water is essential for any mosquito to complete its cycle. The Anopheles larvae can develop in numerous different water habitats, from shaded ponds and pools to hoof prints and car tracks. Anophelines tend to prefer water that is clean. But some Anopheles species have been shown to breed in polluted drains.

Biting behaviour

Anopheles mosquitoes bite preferably from dusk to dawn. In many instances, malaria infected mosquitoes are late night biters whereby older mosquitoes are more likely to be infected. These are often found biting between 12am to 4am. But be careful: Different species of anopheles mosquitoes may have different peaks of biting times, preferences (animals or humans) and different resting habits (indoor or outdoors). Blood fed mosquitoes rest indoor in dry or windy areas where safe, outdoor resting sites are scarce.

Guidelines and recommendations

Broad knowledge exists on all levels of malaria, reaching from the vector, the parasite, its cycle in the mosquito and in the human body, as well as in the field of therapy. The complexity of the disease points out and requires that the whole array of control measures at hand have to be used

simultaneously in order to be successful.

BioVision emphasizes the integrated vector management (IVM) as part of its commitment to alleviate living conditions. To reduce the burden caused by mosquitoes is an important goal within human health.

To fight against mosquitoes requires involvement and concerted actions on different levels.

- **Medical entomologists are required with in-depth knowledge of the vector population and malaria incidence in a given area.**
- **Experienced social workers need to mobilize communities and have to create awareness about malaria.**
- **Education on malaria and the possibility to reduce likelihood to become infected is a key activity.**
- **Experts have to train field staff and support personnel in mapping breeding sites, monitoring mosquito populations and in carrying out interventions.**
- **The establishment and maintenance of contacts with the authorities and stakeholders by project leaders plays an essential role.**

5.1 Breeding sites

Mapping

As already stated, mosquito larvae breed in many different aquatic environments. Those breeding sites need to be located and mapped. Breeding sites change during the rainy and the dry season. A Geographical Positioning System (GPS) is a helpful tool, especially to locate temporary habitats of mosquitoes. The breeding sites are divided into categories based on their properties, e.g. wells, ponds, car tracks. Satellite imaging can be used to classify the infrastructure of an area, including

the land use, e.g. homesteads, agricultural land. The Picture 1 shows *An. gambiae* larvae breeding in a brick making pond.

Treatment of breeding sites with larvicides

Products based on *Bacillus thuringiensis israelensis* (Bti) are ideal to eliminate the larval stages of the mosquitoes present in the water. There are different Bti products (formulations) available. A suitable formulation has to be selected which is uniformly distributed on the water surface. The concentration has to be adjusted in order to reach 100% mortality within 24 h. For Bti interventions in the two BioVision funded projects of Nyabondo and Malindi, Bti formulated as tablets and packed in blisters are used. Bti is safe for humans, life stock and the environment. Bti may even be used to protect from larval breeding in drinking water.

Picture 1

Bti acts fast, but its persistence is limited. The intervals of retreatments have to be determined carefully and adjusted to environmental factors such as the nature of the breeding site, meteorological conditions and the recolonization with mosquito larvae. Interventions are required as soon as third instar larvae are present (Picture 1).

Breeding site (Nyabondo) with Anopheles larvae, ready to be treated.
© Prof. Peter Lüthy

Picture 2

In the two large scale projects Nyabondo (30 km2) and Malindi (16 km2), supported by BioVision, an estimated 6 to 8 Bti-interventions per year are required.
The Bti suspensions are applied with hand operated or motorized knap sack sprayers (Picture 2).

Treatment of a breeding site with Bti (Nyabondo)

© Prof. Peter Lüthy

Monitoring of larvae and adult mosquitoes

Picture 3

The larval populations have to be monitored regularly in representative sentinel breeding sites. Ten 250 ml dips are taken for larval counts, whereby the mosquito species and instars are recorded (Pictures 3, 4).

Monitoring of larvae in an unused swimming pool (Malindi)

© Prof. Peter Lüthy

Picture 4

Anopheles larvae sampled from an unused swimming pool (Malindi)

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Picture 5

CDC light traps are used to catch adult mosquitoes between dusk and dawn in predeter-mined sites, mostly inside homes. The mosquitoes caught are grouped into species and counted (Picture 5,6). The number of adult mosquitoes provides information on the efficacy of the Bti interventions and the species specific composition of the mosquito population.

Monitoring of adult mosquitoes caught in a CDC light trap by a mosquito scout (Malindi)

© Prof. Peter Lüthy

Picture 6

Mosquitoes are grouped according to species and counted

© Prof. Peter Lüthy

5.2 Water management and environmental hygiene

Picture 7

The proper handling of water should be done jointly with specialists, the authorities and the population. Where ever feasible stagnant water must be avoided, removed or replaced weekly. Containers used for water storage must be covered with mosquito tight material such as lids and nettings. Rubbish such as plastic bottles (Picture 7), containers and used tires (Picture 8) should be collected regularly and disposed of.

This plastic bottle has to be disposed of correctly. The water catching concrete bin has to be filled with soil or other material.

© Prof. Peter Lüthy

Picture 8

Tires have to be disposed of or stored inside buildings

© Prof. Peter Lüthy

Picture 9

Trenches should be maintained and cleaned regularly in order to allow optimum drainage (Picture 9). This applies for road side trenches, for gullies and sewers, as well as for irrigation trenches. Managed water

has to flow freely and stagnant spots have to be eliminated (Picture 10).

Drainage of water into a newly constructed trench (Nyabondo)

© Prof. Peter Lüthy

Picture 10

Correct water management. The trench is clean, the water is able to flow Nyabondo

© Prof. Peter Lüthy

Picture 11

Water collecting depressions have to be backfilled. Access for gravid mosquitoes, ready for oviposition, to underground water has to be blocked by closing for example gaps with cement (Pictures 11, 12).

Major problems are abandoned fish ponds (Nyabondo) and temporary unused swimming pools (Malindi). Fish ponds should be re-stocked permanently with fish, and the rain water in unused swimming pools should be drained at weekly intervals. Where this is not possible, Bti treatments have to be carried out.

A man hole with a damaged cover

© Prof. Peter Lüthy

Picture 12

The cover is made mosquito tight with cement my the mosquito scouts (Malindi)

© Prof. Peter Lüthy

5.3 Bed nets

Bed nets have become an important and essential component of IVM. Everyone should have access to an Insecticide Treated Net (ITN). Two kinds of nets are promoted which kills the mosquitoes which come in contact with the fabrics:

- **The standard ITNs, which have to be re-treated with the insecticide (Power-Tabs) every 6 months.**
- **The Long Lasting Insecticide Treated Net (LLITN), which displays insecticidal activity for 3 to 5 years.**

Picture 13

Instruction on the proper use of LLITNs

© Prof. Peter Lüthy

The future lays no doubt in the LLITNs. The dispatch of nets to the population requires well organized structures to assure their proper use. Within the BioVision's IVM projects, campaigns to provide the residents with bed nets, constitute an important element. For example, 4,000 LLITNs have bee distributed within the Malindi project site. Owners of new nets have been instructed and registered (Pictures 13, 14).

Periodic checks are carried to assure that the nets are in place and intact.
Encouraging reports from Kenya state that the malaria victims among children under five were reduced by 50%, i.e. from 34,000 to 16,000. This was mainly attributed to the higher coverage with nets.

Picture 14

See 'Vestergaard Frandsen - Disease Control Textiles' a manufacturer of mosquito nets under www.vestergaard-frandsen.com

Children protected by LLITNs

© Prof. Peter Lüthy

5.4 Information and Education

Creation of public awareness

Picture 15

The mosquito scouts of Malindi, employed by the IVM project

© Prof. Peter Lüthy

The BioVision's malaria projects emphasize the creation of public awareness. Communities and its members can and must contribute to the reduction of the mosquito populations.

The measures are simple, actually based on common sense. The residents are urged to remove stagnant water and to make potential underground breeding sites mosquito tight. Water storage tanks have to be covered. Rubbish needs to be collected. Used tires easily collect water and become breeding sites. The same is true for wreckages of cars and agricultural implements.
Since the vectors carrying malaria have a substantial flying range of one kilometer or more, the creation of public awareness is best organized on a community level by experienced social scientists.

The efficacy of the dissemination of the instructions to the residents needs to be monitored with questionnaires. This is done in the Malindi project. The careful evaluation of the questionnaires

should lead to an improvement of the methodology in awareness creation.

Support staff like the mosquito scouts in Malindi represent an important link between the population and the professionals, responsible for the implementation of the IVM. The mosquito scouts in Malindi (Picture 15) which carry out the mosquito monitoring are acquainted with the residents and present an ideal platform mutual discussions on malaria prevention.

Picture 16

Campaigns of awareness are neither one-time actions nor one-way roads. Malindi organizes an annual mosquito day to create awareness and to promote open dialogues (Picture 16).

The procession on the Annual Mosquito Field Day in Malindi

© Prof. Peter Lüthy

Education

Picture 17

Schools play an eminent role in malaria prevention. Schools in the Nyabondo IVM project collaborate closely with the field staff (Picture

Briefing with the Headmaster and his staff on integration of malaria control into the biology courses (Nyabondo)

© Prof. Peter Lüthy

17).

Malaria cases among school children could be reduced by drainage of stagnant water around the buildings. The drained ground allowed for an extension of play grounds and sport fields. The surroundings of the schools are usually kept very clean with water catching rubbish being absent.

Pictue 18

Biology courses offer an ideal platform to learn more about mosquitoes and infectious diseases (Picture 18).

Demonstration material is available at the doorstep. The knowledge gained at school is brought home and can have a snowball effect.

A school class (Nyabondo) which attends a course in malaria prevention

© Prof. Peter Lüthy

Support by authorities and stakeholders

Picture 19

The BioVisions two malaria control projects have the full support of the authorities and stakeholders which is essential for IVM where public and private property is involved. Regular meetings are organized by the project leaders to inform on the state of the art, to plan and to decide on future actions (Picture 19).

The District Officer of Malindi attends the Annual Mosquito Day and is briefed by Dr. Charles Mbogo, the leader of the IVM project

© Prof. Peter Lüthy

Information Source Links

- **A Layman's Guide to Malaria. 2001. Martine Maurel, updated by Stephen Toovey and Andrew Jamieson.**
- **Centers for Disease Control and Prevention. www.cdc.gov/malaria**
- **International Institue of Rural Reconstruction (IIRR), 1999: Environmental Health, A sourcebook of materials. Malaria**
- **Oxfam. Malaria Manual - Humanitarian Manual. Malaria Control Manual, Introduction. Oxfam International, www.oxfam.org . To view document click here or refer to page on "Publications".**
- **Prof. em. Dr. Peter Lüthy, Institute for Microbiology, Swiss Federal Institute of Technology, 8093 Zurich, Switzerland**
- **WHO Guidelines for the treatment of malaria. To view document click here or refer to page on "Publications".**
- **WHO Website on Malaria. www.who.int/malaria/**
- **Wikipedia. www.wikipedia.org/wiki/Anopheles**

Contact information

- **Orion East Africa Limited, P.O. Box 10170-00100, Nairobi, Kenya. Tel. +254-20-786320/785414. (Supplier of Pesthrin, a natural insecticide/acaricide made from pyrethrum flowers). Email: orion@orioneastafrica.co.ke**
- **Valent BioSciences Corporation (Supplier of preparations of Bacillus thuringiensis israelensis for the control of mosquito larvae). www.valentbiosciences.com**
- **Vestergaard Frandsen (Supplier of mosquito nets and other technologies for disease control in the tropics) www.vestergaard-frandsen.com**

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Malaria

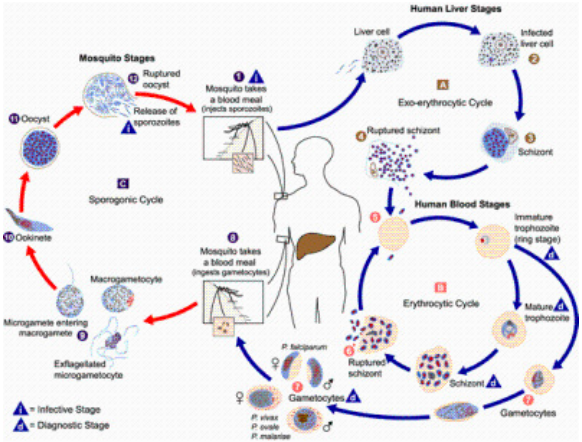
Images

Anopheles sp.

Anopheles gambiae biting human arm

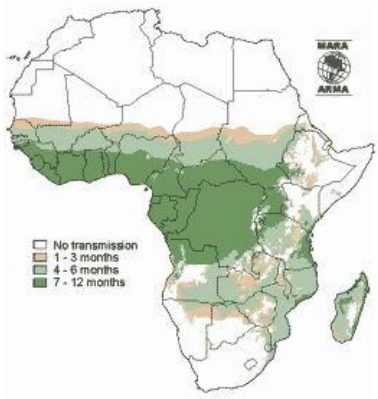
Curtis C.F. (Courtesy of EcoPort, www.ecoport.org)

Plasmodium spp. life cycle.



CDC (Courtesy of EcoPort, www.ecoport.org)

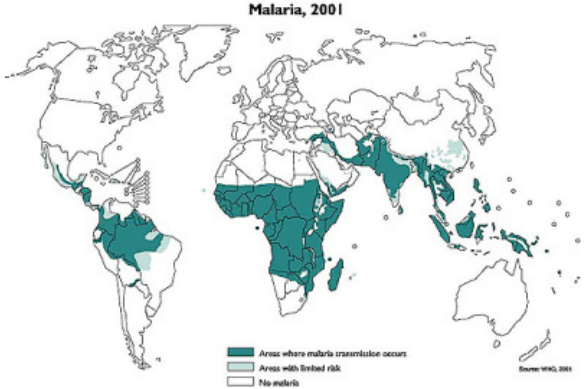
Duration of Malaria Transmission Season



Computer-generated model showing duration of malaria transmission seasons across Africa.

MARA / ARMA Mapping
Malaria Risk in Africa.
www.mara.org.za

Geographical distribution of Malaria



WHO (World Health Organization)
(http://www.who.int/ith/en/)

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Insect Transmitted Diseases

Malaria

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Infonet Human Health

This chapter is under construction. More information will follow soon on water-, soil- and insect borne diseases, basic hygiene, sanitation, waste-management and nutrition etc.

Click below to get information on:

- **Integrated Malaria Control:**
  Control measures on individual and community level, Water- and pond management, Bed nets, Symptoms and medical treatment, Case studies on education and awareness)

- **Nutrition and nutritional diseases:**
Ariboflavinosis, Beriberi, Goiter, Peptic Ulcer Disease, Rickets/Osteomalacia

Infonet Human

This chapter is under construction. More information will follow soon on water-, soil- and insect borne diseases, basic hygiene, sanitation, waste-management and nutrition etc.

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Control measures on individual and community level, Water- and pond management, Bed nets, Symptoms and medical treatment, Case studies on education and awareness)

- **Nutrition and nutritional diseases:**
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Prepacking fruits and vegetables

Introduction

Initial Steps for Basic Processing for fresh fruits and vegetables

Step 1. Sorting. Sorting of raw materials is carried out to ensure the correct quality of materials are processed before the products enter the processing area/facility. This also ensures (1) no time is wasted on processing substandard materials and also minimises the risk of contamination of the final product. Sorting is normally carried

Pre-packing is preparing fruits and vegetables for sale with minimum processing resulting in value addition attracting a higher sales value than the product would otherwise attract when sold in its natural form.

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Labels and Barcodes

and Value addition

Juice

of processing. After this stage there should be no more waste from the initial raw

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reader translates the reflected light into digital data that is transferred to a computer

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Juice

Proper drainage for washing down each day

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Date 'Best before date' is used as an indicator of when the product
This manual system is used for fruit/veg with small seeds like
egrade from optimal quality; this includes when the food becomes

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produce a good yield of juice. The efficiencies of machines can have a huge impact on yield and thus potential income

n for consumer products (excluding foods and medicine) that are

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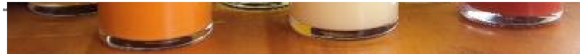
Energy



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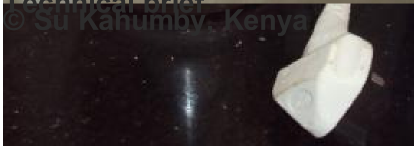
© Dr. S Azam Ali, Practical action Technical brief



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...ice extraction is an optional step used for ... shrink wrap plastic held over the surface of ... bottles of fruit juice per day. After filling hot, ... colour fixing, at same time, protein ... will shrink when it comes into contact with ... 1.5% CO2 ... distribution step, proceed at CO2 ... being placed. Alternatively dip ... wrap sheath into hot water for a few seconds ... then submitted to a sterilising filtration and aseptic ... producing pineapple juice due to a heat resistant ... performed by centrifugation or by enzyme treatment. ... enzyme damages skin after prolonged contact and ... of particles in suspension in the juice and can ... wear gloves to protect their hands. The juice must be ... step. This operation is carried out in centrifugal ... for a longer time to destroy the enzyme (eg boiling ... about 30° C, after a preliminary de- ... 6500 RPM.

... independent stickers to be attached to the ... pectic substance hydrolysis; this will decrease the ... onto the packaging. ... filtration. The treatment is the addition of ... quantity of 0.5 to 2 g/l and will last 2 to 6 hours ... 2 hours at 50° C, a temperature that must not be ...

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Advantages	Disadvantages
...packaging can be done cost effectively with ...	1) Labour intensive
2) Can be made in small quantities	2) Stickers may come off products when wet
3) Can be changed easily	
4) Initial capital outlay is low	

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Sealing

...ic bags that need sealing, and cups that need sealing. For cups using the foil heat sealed lids is adequate and can be done cost effectively to begin with by using a hot iron before upgrading to a more commercial hand sealer.

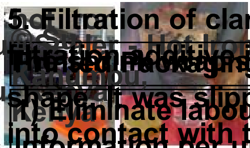
The control of this operation is done by checking the decrease in juice viscosity. Sometimes, the enzyme clarifying is completed with the step called "sticking" by the addition of 5 - 8 g/hl of food grade gelatine which generates a flocculation of particles in suspension by the action of tannins.

Sealing lids

Sealing wrapping foil with an ...

© Su Kahumbu, Kenya

Bar Sealer - Cup Sealer © Su Kahumbu



Hot Iron Sealer © Su Kahumbu, Kenya

5. Filtration of clarified juice can be carried out with kieselgur and bentonite as filtration additives in asbestos filters (equipment).

... placed onto the bottle whilst in a cylindrical shape. It was slipped over the bottle and subject to hot air that caused it to shrink into contact with the bottle surface securing it place.

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Heat Shrinking Advantages	Disadvantages
1) Eliminate labour cost of adding information per unit as with stickers	1) Products are limited to the packaging
	2) Initial start-up costs are high
	3) Change in design not easy ... cost of packaging materials

Quality control

As in all food processing enterprises it is necessary to ensure that the fruit products ... formulated and printed ... requirements, and that ... production costs are minimised ... make any profit. The quality of each day's production should be monitored to ensure that every bottle of juice has the correct keeping and drinking qualities. In particular the following points should be observed:

NAIROBI:

- Kachra Jivraj (K) Ltd, ...
- Allwin Agencies Kenya Ltd, View Park Plaza, Gr Fl, ...
- Interpack Ltd, Sapta Villas, Ndumbi Muringa Rd ...

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Weighing

Scales

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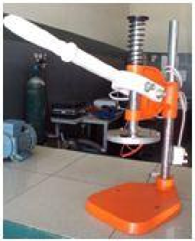

Commercial hand sealer.

© Su Kahumbu, Kenya

- Pay particular attention to the quality of re-usable bottles, check for cracks, chips etc and wash thoroughly before using. If bottles are not able to be sterilized with hot water as in the case of plastic bottles, they can be sterilised in cold water using the sterilising agent Calcium Hypochlorite.
- The concentration of preservative should be carefully controlled for correct preservation of squashes and cordials, and may be subject to local laws. Check first and use accurate scales to measure the preservative.
- The temperature and time of heating are critical for achieving both the correct shelf life of the drink and retaining a good colour and flavour. A thermometer and clock are therefore needed.
- Standardisation of products is a must therefore the correct weight should be filled into the bottles each time

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NAIROBI:

- Avery (East Africa)Ltd Factory St, In Area 55 81 74, 55 85 06/7, Mob. 0734 508506, 0724 259815

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- **Endel Kenya Ltd, Shreeji Hse North Airport Rd, Embakasi 82 41 52/3, Mob 0721 439131, 0734 809949**
- **Papyrus (Africa) Ltd, Wood Products Bldg Falcon Rd, 53 21 13, 53 57 25, 53 57 27**

KISUMU :

- **Avery Scales, Accra St (057) 202 49 60**

ELDORET:

- **Avery Scales (053) 203 00 09**
- **Scales & Pumps Excel (053) 203 25 61**

NYERI:

- **Avery Scales (061) 203 24 49**

NAKURU:

- **Avery Scales (051) 221 04 65**

Blenders and juice extractors

Blenders and juicers

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NAIROBI :

- **Nakumatt Supermarkets country wide**
- **Tusky's**
- **Hot Point P.O Box 402-00606, Sarit Center Parklands Rd, Tel: 374 14 66, 375 22 81 Service Center Falvon Rd off Ent Rd Tel:201 81 46/7/8**

Utensils

Utensils

© Su Kahumbu, Kenya

Available from supermarkets in all major towns in Kenya

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Prepacking fruits and vegetables

Prepacking fruits and vegetables

Introduction

Pre-packing is preparing fruits and vegetables for sale with minimum processing resulting in value addition attracting a higher sales value than the product would otherwise attract when sold in it's natural form.

This minimum processing also results in a "convenient" product that has minimal wastage and optimal quality for the consumer. Pre Packs are normally "portion specific" i.e targeted at a definite

number of consumers e.g two portions, 4 portions, family portions. This is controlled through standardised weights and packages of the pre packed goods.
The minimal processing that products undergo for pre-packing render the product "ready to use". Methods of processing include shredding, slicing, grating, cubing, chopping, whole cleaned top and tailed baby vegetables, topping and tailing, trimming, washing and spin drying e.g leafy veg and herbs, and portioning into florets e.g broccoli and cauliflower.

Hygiene is of outmost importance when value adding through processing or semi processing of vegetables and fruit and should be conducted in a clean custom designed processing area or facility.

Before commencing any processing, veg and fruit must be sorted and pre washed with potable water free of any contaminants. All food handlers must follow a regime of good hygiene depending on the specific duty performed in the processing facility.

Pre packed spring onions

© Su Kahumbu, Kenya

Pre packed sweet corn

© Su Kahumbu, Kenya

Mixed Salad Pack

© Su Kahumbu, Kenya

Garlic

© Su Kahumbu, Kenya

Initial Steps for Basic Processing for fresh fruits and vegetables

Step 1. Sorting - Sorting of raw materials is carried out to ensure the correct quality of materials are processed before the products enter the processing area/facility. This also ensures time is not wasted on processing substandard materials and also minimises the risk of contamination of the final product. Sorting is normally carried out on sorting tables outside of the production facility.

Step 2. Basic pre-packing This is the easiest of pre-packing where a product is merely sorted, weighed and then packed.

Step 3. Washing -This process depends on the level of processing of the final product. If the processing is minimal e.g whole trimmed french beans, washing is not necessary. In the case of prepacked salad packs or shredded sukuma the leaves need washing and drip or spin drying. It is worth noting that washing reduces the shelf life of many fruits and vegetables thus considerations must be made regarding the market, distance and required shelf-life of the processed products. Washing may be necessary to remove foreign matter e.g soil, resins and residues, insects etc especially for fruit and veg that will be peeled before processing.

Small scale production can rely on washing in buckets laid out in a series where products are moved from soiled to fresh potable final rinse water. Washing may also be done with a jet hose. On a larger scale washing may be mechanised. Certain standards and markets may require the use of a sanitiser in the final rinse water. See fresh produce sanitisers at end of page.

It is important to consider recycling used water.

Step 4. Peeling, trimmimg. This process removes the outer skin and other unwanted parts of the fruit or veg from the final product before it is subject to the final stage of processing. After this stage there should be no more waste from the initial raw material. Peeling and trimming should be carried out with stainless steel utensils in order to avoid product discolouration.

Tools for manual production: kitchen peelers
Tools for mechanised production: sandwall peeler - good for potatoes, turnips, carrots

Hand peelers

© Su Kahumbu, Kenya

Basic Processing Methods

1. Shredding and Slicing: Vegetables: Sukuma, Spinach, Cabbage, Courgettes
Fruits: mangoes, pineapples

Manually slicing a courgette
© Su Kahumbu, Kenya

Tools for manual production: stainless steel knives, stainless steel slicers
Tools for mechanised production: food processors, commercial shredders and slicers

2. Grating Vegetables: Most hard vegetables e.g potatoes, carrots, turnips, Swedes, parsnip, sweet potatoes Fruits: Apples,

Manual Graters - stainless steel graters
Mechanised graters - food processors

3. Cubeing/Chipping Vegetables: Same as above for grating
Fruits: Apples, pears, melons

Manually dicing and weighing carrots in punnet **© Su Kahumbu, Kenya**	**© Su Kahumbu, Kenya**	**Manually dicing and weighing carrots in punnet** **© Su Kahumbu, Kenya**

 **Sealing diced carrots in punnet using cling film** **© Su Kahumbu, Kenya**	 **Sealing diced carrots in punnet using cling film** **© Su Kahumbu, Kenya**

Manual Cube/Chipping - domestic potato chipper, stainless steel knives

Mechanised cube/chipping

4. Trimmed Whole Baby Whole baby products refer to products that are minature in size like baby carrots, baby beetroot etc They are normally either harvested at an earlier stage before maturity or grown from seed designed to specifically produce a minature sized crop. Whole baby crops normally attract a higher cost per kg than their mature equivalent. They are niche products often used in niche markets e.g gourmet cuisine restaurants. Of late whole baby products are beginning to appear in mainstream markets.

Vegetables: beetroot, carrots, zuchinni, cabbages, parsnip

5. Trimmed Leaves Prepack trimmed leaves of a variety of products are now found in many manistream markets. Products are washed to remove foreign materials, often sanitised in a vegetable sanitising solution before being dried by spinning or drip drying. Packaging is normally a plastic bag that carries the labelling requirements (link to labelling page) and in some cases information on recipes.

Vegetables: baby spinach leaves, beetroot leaves, parsley, corriander leaves, various types of lettuce and lettuce mixes as well as herbs.

6. Florets Convienient packs of brocolli and cauliflower florets as well as mixes of the two are now popular and comprise of washed and sanitised florets (produced by breaking the cauliflower and brocolli heads into smaller segments dried and packed into plastic bags or punnets.

Vegetables: Brocolli, cauliflower

7. Combination pre packs. Consumer markets are driving producers to develop convenient products in all categories and all food groups. Due to globalisation many people are now exposed to an

increasingly wide variety of food choices in their daily lives. The media in many developed countries now promote exclusive food channels and thus create opportunities for food producers to innovate rapidly. Combination packs have become very popular where combinations of exotic fruits and vegetables enable consumers to easily follow exotic recipes. The Stir Fry pack is possibly the most common combination pack, combining chinese authentic vegetables, pak choi, bean sprouts, baby corn, snow peas, ginger, garlic and lemon grass together. Combo packs allow a producer a certain amount of flexibility, where products that are in plenty can be used in a variety of ways.

Prepack Weights and Packaging

Pre packed products are commonly referred to as convenient products, ready to use with minimal intervention. These products are more expensive than their raw material equivalents and consumers of these products are willing to spend a little more for the convenient aspect of the goods. Weights of pre packed fresh products generally range between 100 - 500 grams for most products, though leafy veg and herbs may vary from 50 - 150 grams. To get accurate measures, it is wise to use a well callibrated electronic digital scale

Weighting

Shredded veg are then weighted to a standardised measurement and packed in either plastic bags or plastic punnets.

Packaging

The packaging is then sealed using a bar sealer (pic, link available from-data sheet machinery) or punnet (pic, link available from-data sheet packaging) lid that is securely taped down. The package must then be labelled (link data sheet labelling) showing all of the statutory requirements

Contact Source Links: Fruit and Veg water sanitisers:

- **Legumatt Available from Eco labs Kenya**

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Labels and Barcodes

Labels and Barcodes

Introduction

Labelling is an important process in the food processing chain. The label is the first point of contact between a consumer and the producer. It is used to identify one product from another and also to make a decision over which product to purchase.

The label is therefore the most important marketing tool for a product. It should be attractive and eye catching while at the same time being informative. A dirty, confused, untidy label will not help to sell a product.

Statutory Labelling Requirements

	Fresh Produce Direct to Market	Semi Processed fresh produce for manufacturing industry	Semi processed for retail markets Prepacks	Juices, Soups, Pickles & Preserves for retail	Juices, Soups, Pickles & Preserves for restaurants	Packed dry fruit and vegetables
Product Name	No	Yes	Yes	Yes	Yes	Yes
Company name and address	No	Yes	Yes	Yes	Yes	Yes
Manufacture and Expiry dates	No	Yes	Yes	Yes	Yes	Yes
Ingredients	No	Yes	Yes	Yes	Yes	Yes
Weight of product	No	Yes	Yes	Yes	Yes	Yes
Nutritional Analysis	No	Optional	Yes	Yes	Optional	Yes
Kebs Standardisation Mark	No	Yes	Yes	Yes	No	Yes

Batch Number	**No**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**
Bar Codes	**No**	**Otional**	**Yes**	**Yes**	**No**	**Yes**
Storage Information	**No**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**
Usage Information	**No**	**Optional**	**Optional**	**Yes**	**No**	**Yes**
Preservatives	**.**	**.**	**.**	**Yes**	**Yes**	**Yes**

Name

This must inform the customer of the nature of the product. It may also be necessary to attach a description to the product name. However, there are certain generic names which must be only used for their conventional uses, for example: Muesli, Coffee, prawns.

Ingredients

All ingredients of the food must be stated under the heading 'Ingredients' and must be stated in descending order of weight. Moreover, certain ingredients such as preservatives must be identified as such by the label ?Preservatives?, a specific name, e.g. "sodium nitrite", and the corresponding registration number colloquially known as an " E number", e.g. "E250".

Nutritional Information

Although it is not a legal requirement to declare nutritional information on the product, if the manufacturer makes claims that the product is 'Low in Sugar', it must be supported with nutritional information (normally in tabulated form). However, as a rule it is recommended to declare nutritional information as consumers more than ever are investigating this information before making a purchase.

Medicinal or Nutritional Claims

Medicinal and Nutritional claims are tightly regulated, some are only allowed under certain

conditions while others are not authorized at all. For example, presenting claims the food product can treat, prevent or cure diseases or other ?adverse conditions? are prohibited. While claiming the food is reduced in fat or rich in vitamins require the food to meet compulsory standards and grades, in addition, the terms must be used in a form specified in regulations.

Date Tagging

There are two types of date tagging:

- **Use by Date ? 'Use by date' must be followed by a day or/and month which the product must be consumed by. To be employed on perishable foods that usually would be kept cold, for example, fish, meat, dairy products and ?ready to eat? salads.**
- **Best Before Date - 'Best before date' is used as an indicator of when the product will begin to degrade from optimal quality: this includes when the food becomes stale, begins to taste ?off? or decays, rots or goes mouldy. There are also regulations on which type of best before date must be applied:**
  - **Best before + Day for foods with a shelf life of up to 3 months**
  - **Best before end + Month for foods with more than a 3 month shelf life.**
  - **Best before end + Year for food with more than an 18 month shelf life**

Storage Conditions

If there are any particular storage conditions for the product to maintain its shelf life, these must be pointed out. However, as a rule it is recommended to always describe the necessary storage conditions for a food product.

Business Name and Address

In addition to the business name and address, it is necessary to indicate the manufacturer or packager, if independent to the main business and the seller.

Place of Origin

The food is required to specify its place of origin, especially if the name or trademark is misleading - such as if the product is called ?English Brie Cheese? when it is produced in Kenya.

Instruction for Use

This is only necessary if it is not obvious how to use or prepare the product, in which case the consumer's own initiative must be used.

Presentation

The label must be legible and easy to read, also it must be written in English, however, the manufacturer may also include other languages.

Lot Mark or Batch Code

It must be possible to identify individual batches with a lot mark or batch code - the code must be prefixed with the letter ?L? if it can not be distinguish from other codes, however, the date mark can be used as a lot mark. Manufacturers must bear in mind that the smaller the size of a batch, the smaller financial consequences in the case of a product recall.

Sectioning

All of the following must be in the same field of vision:

- **Product name**
- **Date mark**
- **Weight**
- **Quantity**
- **Alcohol strength (if applicable).**

Standard specification

Indicate the level of the standard compliances which the product are manufactured and packaging are completed against, and the specification limits if the standard is not publicly available, especially for those of

- **Microbial limits**
- **Heavy metal limits**
- **The limits of pesticide residuals**
- **The limits of preservatives artificial flavouring and colouring etc.**

Food additives

With a best practice, the items should be presented by their approved names (i.e. domestically), functional classes, and numbers of International Numbering System (INS) or equivalent .

Ecolabel

is a labelling system for consumer products (excluding foods and medicine) that are made in a certain fashion to avoid detrimental effects on the environment. Usually both the precautionary principle and the substitution principle are used when defining the rules for what products can be ecolabelled. Many (but not all) ecolabels are not directly connected to the firms that manufacture or sell the ecolabelled products. Just as for the quality assurance labelling systems it is of imperative importance that the labelling entity is clearly divided from and independent of the manufacturers. All ecolabelling is voluntary, are not mandatory by law.

Ecolabelling systems exist for both food and consumer products. Both systems were started by NGO?s but nowadays the European Union have legislation for the rules of ecolabelling and also have their own ecolabels, one for food and one for consumer products. At least for the food the ecolabel is nearly identical with the common NGO definition of the rules for ecolabelling. Many of the food ecolabels follow the recommendations from the International Federation of Organic Agriculture Movements (IFOAM) that started in the 1970s.

Barcoding

A bar code (often seen as a single word, barcode) is the small image of lines (bars) and spaces that is affixed to retail store items, identification cards, and postal mail to identify a particular product number, person, or location.

The code uses a sequence of vertical bars and spaces to represent numbers and other symbols. A bar code symbol typically consists of five parts: a quiet zone, a start character, data characters (including an optional check character), a stop character, and another quiet zone.

A barcode reader is used to read the code. The reader uses a laser beam that is sensitive to the reflections from the line and space thickness and variation. The reader translates the reflected light into digital data that is transferred to a computer for immediate action or storage.

Bar codes and readers are most often seen in supermarkets and retail stores, but a large number of different uses have been found for them. They are also used to take inventory in retail stores; to check out books from a library; to track manufacturing and shipping movement; to sign in on a job; to identify hospital patients; and to tabulate the results of direct mail marketing returns.
Very small bar codes have been used to tag honey bees used in research.

Readers may be attached to a computer (as they often are in retail store settings) or separate and portable, in which case they store the data they read until it can be fed into a computer.

There is no one standard bar code; instead, there are several different bar code standards called symbologies that serve different uses, industries, or geographic needs.
Since 1973, the Uniform Product Code (UPC), regulated by the Uniform Code Council, an industry organization, has provided a standard bar code used by most retail stores. The European Article Numbering system (EAN), developed by Joe Woodland, the inventor of the first bar code system, allows for an extra pair of digits and is becoming widely used.

Information Source Links

- **Appropriate Food Packaging Fellows P and Axtell B (2002). ITDG Publishing.**
- **Codex Alimentarius Committee on Food Labelling www.codexalimentarius.net**
- **Codex General Standard for the labelling of pre-packaged foods. www.fao.org**
- **Guidelines for Small Scale Fruit and Vegetable Processors Fellows, P (1997). FAO Agricultural Services Bulletin 127, FAO, Italy, Rome. www.fao.org**
- **Practical action: Food Labelling Technical Brief www.practicalaction.org**
- **SearchManufacturingERP .com searchmanufacturingerp.techtarget.com Accessed 19/01/10**

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Juice making

Juice making

Introduction

A wide range of drinks can be made using extracted fruit juice or fruit pulp as the base material. Many are drunk as a pure juice without the addition of any other ingredients, but some are diluted with sugar syrup. The types of drink made from fruit can be

Different juices

© Su Kahumbu, Kenya

separated into two basic types;

- **Those that are drunk straight after opening**
- **Those that are used little by little from bottles which are stored between use.**

The former groups should not require any preservative if they are processed and packaged properly. However, the latter group must contain a certain amount of permitted preservatives to have a long shelf-life after opening.

Carrot, beetroot carrot mix juice

© Su Kahumbu, Kenya

Natural Juices - Pure fruit juice with nothing added

Guava nectar

© Su Kahumbu, Kenya

Nectars - Normally contain 30% fruit solids and are drunk immediately after opening

Orange squash

© Su Kahumbu, Kenya

Squashes - Normally contain at least 25% fruit pulp mixed with sugar syrup. They are diluted to taste with water and may contain

Lime cordial

© Su Kahumbu, Kenya

Cordials - Are crystal-clear squashes

preservatives

Concentrates - Juices where water is extracted form the juice

Syrups - Are concentrated clear juices.

They normally have a high sugar content Each of the above products is preserved by a combination of natural acidity, pasteurisation and packaging in sealed containers. Some drinks (syrups and squashes) also contain a high concentration of sugar which helps to preserve them.

Mango nectar

© Su Kahumbu, Kenya

Kiswahili Version

Aina mbalimbali ya vinywaji vinaweza kutengenezwa kwa kutumia juisi ya matunda kama malighafi ya kimsingi.Vinywaji vingi hutumiwa kama juisi. Vinywaji vingi hutumiwa kama juisi mahususi bila ya kuongezwa viungo vingine, lakini baadhi huongezwa sukari. Aina ya vinywaji vinavyotengenezwa kutokana na matunda vinaweza kuwekwa katika makundi mawili makuu kimsingi:

- **Vile ambavyo vinaweza kutumiwa punde tu baada ya pakiti zao kufunguliwa.**
- **Vile vinavyochoviwa kidogokidogo kutoka kwenye chupa na hatimaye kuhifadhiwa baada ya kutumiwa.**

Kundi la kwanza halihitaji kiungo chochote cha kufanya vinywaji hivyo vidumu iwapo vimeandaliwa na kupakiwa vizuri.

Hata hivyo, kundi la pili la vinywaji lazima liwe na kiwango fulani cha kemikali kilichoruhusiwa

kuvihifadhi ili vidumu iwapo vimeandaliwa na kupakiwa vizuri. Aina mbalimbali ya vinywaji huwekwa katika makundi kulingana na utaratibu ufuatao.

Fruit and Veg Juice Processing

Fruits and veg can be categorised into soft pulpy e.g papaya, manago, peaches, avocado, tomato and hard e.g apples, pears, carrots, beetroot . Whilst most hard fruits/veg can be processed into both clarified "clear" juices as well as "nectar" pulp juices, soft pulpy fruits/veg are not so easy to produce clarified juices and are more commonly processed into fruit/veg nectars. Almost all juices can be turned into concentrates.

Selection of fruit/veg to use for juice is very important. They must be mature, clean and free from any mould, bruising or rot, they must also not contain any chemical or other contaminant residues.

Processing facility

It is important to select a clean working space to process fruit and vegetables. This space may be in the form of a small kitchen, a small production facility or a larger processing facility.

The facility must ensure the following:

- **A potable water supply including hot water. Water quality is critical, if in doubt use boiled water or add one tablespoon of bleach to each gallon of water to sterilise it. If water is cloudy, a water filter should be used.**
- **Preferably electricity**
- **Screened windows and doors to reduce insects**
- **No horizontal ledges, window sills, or rafters where dust, insects and bird droppings can**

collect.

- **Clean hard surface preferably steel working surfaces**
- **Separate storage area for chemicals, packaging materials and cleaning materials**
- **Sloping concrete floor**
- **Proper drainage for washing down each day**

The processing area must be set up logically to ensure there is no risk of cross contamination within the processing space and operations.

Juicing step-by-step

1. Pre sorting - Fruit/veg arrives into a processing area by many means and in many packaging forms. Pre sorting ensures rotten and poor quality products are removed in the very early initial stages of processing. It is wise that this process of pre sorting happens outside of the hygienic confines of the production area to ensure there is no risk of cross contamination. Pre sorting personnel must also be subject to the hygienic regulations of the facility and must ensure that they do not create cross contamination via unwashed hands, dirty overalls or clothing and footware.

2.Washing - Washing of fruit/veg is carried out to remove all external debris and contamination. This is commonly the initial process carried out within the confines of the production facility and often food grade sanitising chemicals are used as sterilising agents.

3. Sorting - A final sorting is done to ensure there are no internal contaminants e;g worms or other

bugs. For optimum efficiency this operation is carried out on sorting tables or moving inspection conveyor belts within the production facility.

4. Peeling and Seed removal - Depending on the scale of production, some fruits/veg require skins and seeds to be removed before processing: e.g. Mangoes, peaches, papaya, pineapples, avocado.

5. Cutting - Depending on the scale of production and machinery used for processing, some fruit/veg require cutting into optimal sizes for machinery or process used: e.g. mango, carrot, beetroot.

Manual Juice Making

This is a basic form of making juice without the help of any electrical machinery. The process is labour intensive and sometimes a less efficient extraction method.

Manual juicer

© Su

After steps 1 - 5 above, the following processes are carried out, depending on the fruit/veg type.

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Hand power pulper

© Apropedia Practical Action Brief

1. Squeezing or pressing

Fruit/veg are squeezed or pressed using manual appliances. This system is efficient for very small scale restaurant production where volumes required are not very high. In the case of citrus, skins are not removed.

2. Sieving/Pulping

This manual system is used for fruit/veg with small seeds e.g passion fruits.

Small scale fruit/veg juice production using electric appliances

Steps 1 - 5 are followed as above before fruit/veg are subject to crushing, grinding or disintegration using various electrical appliances.

1. Disintegration through process of blending

Soft fruits/veg may be blended using commercial blenders resulting more often in "nectars" where the pulp remains in the final product. Fruits/veg processed like this often include mango, pineapple, papaya,tomato, avocado etc and also many


Blender
© Su Kahumbu, Kenya

combinations of these creating fruit "mixes" or "smoothies". For further information on blenders click here

2. Crushing Juicy fruits with small seeds are often put through a process of crushing where the seeds, skins and unwanted pulp are removed from the final process.

3. Grinding Juices of fruits such as apples and pears are extracted through the process of grinding.

4. Centrifugation Centrifugation achieves a separation of particles in suspension in the juice. Many electric juices use this principle where fruit mass is spun at speeds of 6000 to 6500 RPM (rotations per minute) through a sieve that retains the seeds and unwanted pulp mass. Centrifugation can be considered as a pre-clarifying step.

Commercial juicers crushes, grinds and centrifuges - especially good for pineapples and passion fruit. Fruit is pushed through the feeding mouth of the machine and is pulverised on a rotating disc before the pulp is spun against a very fine filter, thus fruits normally needing grinding and crushing can be juiced. The seeds and pulp are expelled from the side shute on the machine.

N.B Citrus fruit are normally juiced using special citrus juicers as their skins contain oils that will create the juice to taste bitter. There are many types of electric citrus juicers on the market ranging from domestic use to commercial.

Domestic citrus juicer good for limes, lemons, oranges, tangerines etc.

Citrus juicer

© Su Kahumbu, Kenya

When buying juicing machinery, be sure to look for models that produce a good yield of juice. The efficiencies of machines can have a huge impact on yield and thus potential income.

For further information on machinery and utensils click here

Commercial juicer

© Su Kahumbu, Kenya

Maximising on fruit extraction efficiency, colour, clarification and taste

1. Enzyme treatment -To improve extraction yield , taste and colour fix of some juices, enzyme

treatment with 2 - 8% pectolitic enzymes is used at 50ºC for 30 minutes.

However, for fruit which is naturally rich in pectic substances e.g citrus, this treatment makes the resulting "exhausted" material useless for industrial pectin production.

2. Heating of crushed fruit mass before juice extraction is an optional step used for some fruit in order to facilitate pressing and colour fixing; at same time, protein coagulation takes place.

3. Juice Clarification - can be performed by centrifugation or by enzyme treatment. Centrifugation achieves a separation of particles in suspension in the juice and can be considered as a pre-clarifying step. This operation is carried out in centrifugal separators with a speed of 6000 to 6500 RPM.

4. Enzyme clarifying is based on pectic substance hydrolysis; this will decrease the juices' viscosity and facilitate their filtration. The treatment is the addition of pectolitic enzyme preparations in a quantity of 0.5 to 2 g/l and will last 2 to 6 hours at room temperature, or less than 2 hours at 50° C, a temperature that must not be exceeded.

The control of this operation is done by checking the decrease in juice viscosity. Sometimes, the enzyme clarifying is completed with the step called "sticking" by the addition of 5 - 8 g/hl of food grade gelatine which generates a flocculation of particles in suspension by the action of tannins.

5. Filtration of clarified juice can be carried out with kieselgur and bentonite as filtration additive in press-filters (equipment).

Fruit juice preservation

Fruit juice preservation

1. Pasteurisation: This requires raising the temperature of the juices to 80 - 95°C for 1-10 minutes prior to filling hot. At the simplest level, this may be carried out in a stainless steel, enamelled or aluminium saucepan over a gas flame, but this can result in localised overheating at the base of the pan, with consequent flavour changes. To avoid the use of large expensive, stainless steel pans, a large aluminium pan can be used to boil sugar syrup. A given amount of the syrup is then mixed with fruit juice in a small stainless steel pan and this increases the temperature to 60 - 70°C. The juice/syrup mixture is then quickly heated to pasteurising temperature.

2. Preservation under CO_2 pressure may be done at a concentration of 1.5% CO_2 under a pressure of 7 kg/cm². At the distribution step, proceed at CO_2 decompression and the juice is then submitted to a sterilising filtration and aseptic filling in receptacles.

3. Preservation by freezing is carried out at about -30° C, after a preliminary de-aeration; storage is at -15 to -20° C.

Filling, Bottling and Packaging

Juices can be packaged in many different ways. Bottles, glass and plastic, tetra packs of different shapes and sizes, plastic pouches and even cups can be used. All packaging must ensure no leakages.

Filling and bottling

In all cases, the products should be hot-filled. A stainless steel bucket, drilled to accept a small outlet tap, has proved to be a very successful filler. Output can be doubled quite simply by fitting a second tap on the other side of the bucket. This system can be used to produce 500-600 bottles of fruit juice per day. After filling hot, the bottles are capped and laid on their sides to cool prior to labelling.

- **Note: Care is needed when producing pineapple juice due to a heat resistant enzyme in the juice. The enzyme damages skin after prolonged contact and workers should therefore wear gloves to protect their hands. The juice must be heated to a higher temperature for a longer time to destroy the enzyme (eg boiling for 20 minutes).**

Packaging
Small scale production packaging can be done cost effectively with plastic bottles, plastic bags that need sealing, and cups that need sealing. For cups using the foil heat sealed lids is adequate and can be done cost effectively to begin with by using a hot iron before upgrading to a more commercial hand sealer.

Sealing lids heating the foil with an hot iron

© Su Kahumbu, Kenya

Quality control

As in all food processing enterprises it is necessary to ensure that the fruit products are correctly formulated and priced to meet the customer's requirements, and that production costs are minimised to ensure that a profit is made. The quality of each day's production should be monitored and controlled to ensure that every bottle of juice has the correct keeping and drinking qualities. In particular the following points should be observed:

Commercial hand sealer.

© Su Kahumbu, Kenya

- **Pay particular attention to the quality of re-usable bottles, check for cracks, chips etc and wash thoroughly before using. If bottles are not able to be sterilized with hot water as in the case of plastic bottles, they can be sterilised in cold water using the sterilising agent Calcium Hypochlorite.**
- **The concentration of preservative should be carefully controlled for correct preservation of squashes and cordials, and may be subject to local laws. Check first and use accurate scales to measure the preservative.**
- **The temperature and time of heating are critical for achieving both the correct shelf life of the drink and retaining a good colour and flavour. A thermometer and clock are therefore needed.**
- **Standardisation of products is a must therefore the correct weight should be filled into the bottles each time**

Labelling tips

Information carried on packaged juices must include all statutory requirements including the following:

1. Product Name
2. Company name and address
3. Manufacture and Expiry dates
4. Ingredients
5. Weight of product
6. Nutritional analysis
7. Kebs Standardisation Mark
8. Batch Number
9. Barcodes (for main stream markets only)
10. Storage Information
11. Usage Information
12. Preservatives

This information can be carried on independent stickers to be attached to the packaging or can be printed directly onto the packaging.

Sticker Advantages	Disadvantages
1) Can be used on different packaging	1) Labour intensive
2) Can be made in small quantities	2) Stickers may come off products when wet
3) Can be changed cost effectively	

4) Initial capital outlay is low	

Printed Packaging Advantages	**Disadvantages**
1) Eliminate labour cost of adding information per unit as with stickers	**1) Products are limited to the packaging**
	2) Initial start up costs are high
	3) Changes are not easy to make and can result in voluminous waste of packaging materials

Shrink wrapping

Shrink wrapping is used to ensure security on lids of products as well as for labelling. Heat in the form of hot air or hot water is used to shrink a plastic film around the top of bottles or entire bottles when used for labelling. The end products look very professional. The advantages of labelling this way allow one to purchase generic empty packaging as in bottle or cups and then label in batches as needed rather than going through the process and cost of labelling minimum volumes of printed packaging which can be prohibitively expensive for the small scale and start up produce. To shrink wrap, simply blow hot air using a device as simple as a hair drier or commercial blow drier onto the shrink wrap plastic held over the surface of the product to be covered. The plastic will shrink when it comes into contact with the heat and securely cover the mould over which it is being placed. Alternatively dip the entire product with the shrink wrap sheath into hot water for a few seconds, remove and dry.

Shrink wrapping

© Su Kahumbu, Kenya

The shrink wrap sheat in the picture was heated onto the bottle whilst in a cylindrical shape. It was slipped over the bottle and subject to hot air that caused it to shrink into contact with the bottle surface securing it place.

Information Source Links

- **www.practicalaction.org**

Fruit Juice processing Practical Action Technical Brief
Mixed fruit Juice Manufacture Practical Action Technical Brief
Lime juice Practical Action Technical Brief
Lime cordial Practical Action Technical Brief
Nas naran lime juice Practical Action Technical Brief

Passion fruit juice Practical Action Technical Brief
Liquid filling and packaging Practical Action Technical Brief
Small-scale of ready to drink pineapple juice Food Chain No 27

Contact Source Links: Juicing Machinery available from

- **Food Grade sanitisers available from Ecolabs East Africa Ltd, Box 63497-00619 Nairobi; info@ecolabs.co.ke, 0722 204 170, 0733 620 718, Landline: 856 22 34, 856 05 47**
- **JohnsonDiversey East Africa Ltd., Tel: (254) 20 422 4000 Hygiene Centre, Kabete, Fax: (254) 20 422 4888 Kaptagat Road, Loresho, P.O. Box 41939, 00100 GPO NAIROBI**

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Machinery and Utensils - Where to get

Images

Citrus juicer

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Prepacking fruits and vegetables

Images

Baby carrots pre packed

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Labels and Barcodes

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